

# SEDAP

**A PROGRAM FOR RESEARCH ON**

**SOCIAL AND ECONOMIC  
DIMENSIONS OF AN AGING  
POPULATION**

**Alternative Pasts, Possible Futures: A “What If”  
Study of the Effects of Fertility on the Canadian  
Population and Labour Force**

**Frank T. Denton  
Christine H. Feaver  
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**SEDAP Research Paper No. 67**

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## ABSTRACT

### ALTERNATIVE PASTS, POSSIBLE FUTURES: A “WHAT IF” STUDY OF THE EFFECTS OF FERTILITY ON THE CANADIAN POPULATION AND LABOUR FORCE

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McMaster University

The “baby boom” that followed World War II, and the subsequent “baby bust”, have cast a long shadow over the Canadian population, society, and economy. Drawing on a series of counterfactual projections, this paper considers what the year 2001 would have looked like if things had been different – if there had been no baby boom or no bust, or if the bust had been delayed, to take three examples. The paper then considers what will happen in the coming decades under a number of alternative assumptions. A major finding is that the boom had much less impact on the 2001 age structure of the population and labour force than did the bust that followed. For the future, population aging, slower rates of growth, and increased dependency ratios are likely features, but one should be careful not to overestimate the prospective “dependency burden”.

ALTERNATIVE PASTS, POSSIBLE FUTURES: A “WHAT IF” STUDY OF THE EFFECTS  
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1. INTRODUCTION

The “baby boom” that followed World War II, and the subsequent “baby bust”, have cast a long shadow over the Canadian population, society, and economy. The children of the boom are now adults in early to late middle age, and within the first few decades of this century will be leaving the labour force and moving into the retirement phase of their lives. The children of the bust will have taken their place in the working population, but in numbers reflecting the greatly reduced fertility rates of the last third of the 20<sup>th</sup> century. The implications for the age structure and rates of growth of the population and labour force and for pensions, health care, and other components of government budgets are widely recognized in broad terms, and have been probed in some detail in a number of studies<sup>1</sup>. Some of the consequences of the predicted rise in the proportion of the population in old age are mitigated slightly by recognizing that the definition of “old” will need revising upwards in light of gains in life expectancy and improvements in the average health status of people in their 60s, 70s, and above (Denton and Spencer, 1999). But that is a minor consideration. The principal one is that population aging, with its roots in the history of Canadian fertility rates, is in progress today, and will continue.

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The demographic past is implicit in the current age structure of the population, as represented by what traditionally has been referred to as a population “pyramid” (although its shape today can hardly be said to be pyramidal). But what if the history of fertility had been different? What if there had been no baby boom; what then would today’s “pyramid” look like? Or what if there had been no baby bust, or neither a boom nor a bust; what sort of population would Statistics Canada have found in its 2001 census? We explore those questions and some others by rewriting demographic history in a number of counterfactual ways, and recalculating the population of 2001 accordingly, going back to 1951 and carrying out a series of 50-year “what if” simulations for different fertility scenarios, and for comparison two other scenarios, one in which there is no migration (in or out of the country) and one in which labour force participation rates are held constant at their 1951 levels. Our aim in doing all of this is to bring out more clearly the role played by fertility rates in determining the characteristics of the population as we see it today, and the corresponding characteristics of the labour force.

The consequences of changes in fertility rates in the last half of the 20<sup>th</sup> century having thus been explored by counterfactual simulation, we then look ahead and consider prospective consequences for the population and labour force in the first half of the present one. We do that by presenting a series of projections under alternative assumptions about future fertility levels, ranging from scenarios in which there are further declines to ones in which there are sharp increases. As before we include also, for comparison, some scenarios relating to migration and labour force participation. In assessing the results of our historical simulations and projections we take note of the size and rates of growth of the population and labour force, selected indicators of age distribution, and dependency ratios of two kinds, one based solely on population, the other on the ratio of population to labour force.

## 2. A BRIEF HISTORY OF CANADIAN FERTILITY

A brief review of the history of Canadian fertility helps to set the stage for what follows. In the “what if” simulations and projections we shall focus on the total fertility rate (TFR) as an indicator of the general fertility level, and so as background we look at the history of that rate. There have of course been shifts in the age distribution of fertility too but a general measure such as the TFR captures the dominant movements, in particular the baby boom and baby bust sequence.

The annual series of TFRs is shown in Figure 1 from 1921 to 1998, the latest year for which a rate is available from Statistics Canada at the time of writing. The TFR is defined on a period basis. Rates have also been calculated for birth cohorts (completed cohort fertility rates, that is) extending back to the 1890s; see Romaniuc (1984, p. 13), Bélanger, Carrière, and Gilbert (2001, p. 36). For much of the time since 1921 the cohort rates do not differ greatly from the period rates, when put on a comparable basis. (In Romaniuc, 1984, the annual period rates are matched with the age-27 cohort rates, in Bélanger, Carrière, and Gilbert, 2001, they are matched with the age-28 cohorts, those ages being used to approximate the modal age of mothers at childbirth.) There are, though, substantial differences from the 1940s through to the mid-1960s, roughly the period of the baby boom, as we shall define it. The boom evidenced by the cohort series is notably less pronounced than the one evidenced by the period series. However, the period-based series reflects more closely what one usually thinks of as the boom and bust fertility sequence, and the period rates are much easier to work with for simulation and projection purposes. We therefore focus on the period TFR in this section and the ones that follow, and for convenience, where the meaning is clear, we often use the word fertility to mean simply the TFR.

The dominant time-series patterns displayed by Figure 1 are well known. Fertility was on a generally downward path until the late 1930s, then started to move up, and moved up sharply in

the immediate post-war period, thus initiating the baby boom. The boom itself reached a peak of just under four children per woman in 1959. The decline that followed continued for virtually the next four decades, very rapid at first, then much slower, producing by 1998 a TFR of 1.54. However, the rates remained very high by pre-war standards through the first half of the 1960s. What seem to be generally accepted definitions place the boom period at 1946 to 1965 and the beginning of the bust at 1966. Those definitions are of course rather arbitrary, as the figure makes clear. However, we shall adopt them for purposes of creating our “what if” scenarios in the next section. (Defining the boom and bust periods from the TFR series is much like the economist’s problem of defining periods of expansion and contraction in the business cycle; in both cases some degree of arbitrariness is unavoidable.)

The boom and bust fertility sequence has had major effects throughout the society and the economy. Of particular significance have been the effects on the supply of labour. The average lag between births and entry into the labour force can be taken (very roughly) to be about two decades. On that basis, the children of the 1950s were pouring onto the job market in the 1970s, and the history of labour force growth rates reflects that. (The historical time series of growth rates is plotted and discussed in a later section, together with projected rates.) The rate of growth reached its highest level in the 1970s and then fell off sharply as the delayed effects of fertility declines came to be felt. That is not to say that all growth comes from the entrance of young people into the job market; immigration and rising participation rates of women have played important roles too in the past half-century. But in largest measure it is the delayed impact of fertility that underlies the historical pattern of rise and subsequent decline in the rate of growth of the Canadian labour force.

### 3. REWRITING THE PAST: SOME COUNTERFACTUAL HISTORICAL SCENARIOS

There are eight historical scenarios, to which we attach numbers. (Letters are attached to the future scenarios described later.) In each case we make a counterfactual assumption about the history of fertility, or in one case about migration and in another about labour force participation rates. We observe the primary effects of each assumption over the 1951-2001 half-century but make no attempt to deal with possible secondary effects. The primary effects of a change in the historical fertility pattern would be on the size and age distribution of the population, and hence on the size and age distribution of the labour force. Secondary effects might be changes in labour force participation rates consequent on there being more or fewer children to care for, changes in levels of immigration resulting from revisions of government policy in light of the altered numbers of workers from within the domestic population, changes in the numbers of people emigrating to the United States or elsewhere, changes in income levels (which might in turn affect participation rates and migration), and so on<sup>2</sup>. It is well beyond the scope of our study to try to allow for such secondary (or higher order) effects; that would require many additional (and speculative) assumptions. Bearing in mind that caveat we define our eight “what if” scenarios as follows:

(1) What actually happened? This is the “no rewriting of history” scenario; it provides the base case for comparisons with the others.

(2) What if there had been no baby boom? Starting with the actual population in 1951 we apply the (pre-boom) 1945 age-specific fertility rates to the female population in every year from 1951 to 1965. The actual fertility rates are then applied in all subsequent years. Here as elsewhere, unless otherwise noted, migration and labour force participation rates are at their actual levels in every year from 1951 to 2001. The time series fertility patterns for this scenario and the next four are shown in Figure 2. (For convenience we chose



1951 as the starting year for simulating this and the other scenarios, thus ignoring in the present case the fact that the 1951 population already incorporates some early boom effects resulting from the 1946-1950 fertility rates – ignoring the effects of those rates on the starting population in the age group 0-5, that is. This is a minor impurity in our “no boom” specification which we decided to live with in order to stick with the same 50-year historical period for all scenarios and avoid the difficulties of obtaining consistent labour force data for the pre-1951 years, allowing for the entry of Newfoundland into the confederation in 1949, and some other problems. Rough estimates are that the 0-4 population would have been 13 percent lower in 1951 if the TFR had remained at its 1945 level throughout the period 1946-1950, and the total population 1.6 percent lower.)

(3) What if there had been no baby bust? In this case we restore the 1951-1965 fertility rates to their actual levels but freeze all of the subsequent rates at the 1965 levels.

(4) What if there had been neither a baby boom nor a baby bust? The annual fertility rates are frozen at their 1945 levels throughout the whole of the 1951-2001 simulation period in this scenario.

(5) What if the baby bust had been delayed for a decade? Adopting the (as noted earlier, common if somewhat arbitrary) assumption that the baby bust actually started in 1966, we now delay it for a decade. That is to say, we hold fertility rates at their 1965 levels in every year from 1966 to 1975. The year 1976 then has the actual 1966 rates, 1977 has the actual 1967 rates, and so on down to 2001, which has the 1991 rates.

(6) What if the baby bust had stopped at the natural replacement level? In this one we stop the total fertility rate from falling below 2.1, which to a close approximation is the natural replacement level. What that means is that the actual TFR in 1972 and each subsequent year is replaced by 2.1. We refer to this scenario as “moderated bust.”

(7) What if there had been no migration? This is the first of the two scenarios in which the counterfactual assumption applies to something other than fertility. We assume here that there was no immigration or emigration in any year of the simulation period. A comparison of the results of this scenario and the next one with those of the previous scenarios helps to place the effects of fertility in a broader context.

(8) What if labour force participation rates had not changed? The participation rate in each age-sex group is held constant at its 1951 level in this scenario. (There are seven age categories, corresponding to those defined for the Statistics Canada Labour Force Survey: 15-19, 20-24, 25-34, 35-44, 45-54, 55-64, and 65 and over.) There were in fact significant changes in male participation rates over the half-century, most notably declines in the rates for older groups, and of course very large increases in the rates for women. Both types of change are eliminated in this scenario. (Note: The definition of the labour force in this paper includes an estimated allowance for members of the Armed Forces and residents of the Yukon and Northwest Territories, and is therefore slightly more comprehensive than that of the Statistics Canada Labour Force Survey.)

The simulation of the various scenarios required historical annual series of fertility rates by age and immigration, emigration, mortality rates and labour force participation rates by age and sex, as well as some other input data. The simulations themselves were carried out using procedures generally similar to those of a standard type of demographic projection model (in particular MEDS, our own projection model; see Denton, Feaver, and Spencer, 1994b, 1997). It was not possible to assemble all of the required historical data in the detail that is available for today and some supplementary assumptions and approximations were required to fill out the input data set. The instrument of control for the fertility scenarios is the total fertility rate, and given the TFR, the age-specific rates were then approximated by a Gompertz function. The

Gompertz function has three parameters; it was fitted to the actual historical rates for each year and then adjusted by altering the parameter representing the TFR, as required for a given scenario, leaving unaffected the other two parameters, which represent the age distribution of fertility. (The Gompertz function provides a close fit to the age-specific rates; see Denton and Spencer, 1974, 1975b.) As a test we ran the scenario 1 simulation – the “what actually happened” one – using the data set thus created, generated results for the year 2001, and compared them with actual values for that year (or with the preliminary estimates that were available at the time of writing). The simulated results for population and labour force size, growth rates, and age characteristics, and for the two types of dependency ratios, were very close to the actual values; the model procedures were thus able to generate figures quite similar to actual ones after 50 years of simulation. The simulated total population, for example, differed from the actual one (i.e., the Statistics Canada preliminary estimate for July 1, 2001) by only 2.7 percent. (We found that reassuring, given that the actual population had grown by 117.9 percent over the 50-year period.) To take another example, the simulated ratio of population to labour force was 1.93, compared with an actual value of 1.90. To achieve consistency we used the differences between the simulated and actual 2001 values for scenario 1 to adjust the simulated 2001 results for the other scenarios.

#### 4. IMPLICATIONS FOR THE YEAR 2001

What would 2001 look like (demographically speaking) under the various 50-year counterfactual scenarios? To answer the question we present some summary results in Table 1. For the population the table shows size (in thousands and in index form, with the actual population of scenario 1 equal to 100.0), five-year growth rate (over the period 1996-2001),

median age, and percentages in the age groups under 20 and 65 and over. For the labour force it shows size (again in thousands and in index form), growth rate, and median age. The table also shows two types of dependency ratio: the ratio of the total population to the population aged 20 to 64 (the latter being a rough approximation to the working-age population), and the ratio of the total population to the labour force (presumably a better measure of “dependency”).

Scenario 1 is the actual one. The population at mid-year was about 31.1 million, the five-year growth rate was 4.8 percent, the median age was a little over 37, the population under 20 accounted for somewhat more than a quarter of the total and the population 65 and older for somewhat less than 13 percent. The labour force component of the population numbered 16.3 million, with a 5-year growth rate of 8.8 percent and a median age of about 39. As rough indicators of “dependency” there were 1.62 people in the overall population for every person in the age range 20-64, or 1.90 people per member of the labour force. Such was the state of things after half a century of boom and bust in fertility rates, high (and fluctuating) levels of immigration, and profound shifts in patterns of labour force participation, especially among women.

What if there had not been a baby boom (scenario 2); what then would 2001 have looked like? The population would of course have been smaller than in scenario 1 – by about 2.2 million, or 7 percent – and the labour force would have been smaller accordingly, and would have been growing more slowly, though only a little (8.1 compared with 8.8 percent). But perhaps the most interesting result of the counterfactual calculation is that in broad terms the proportionate age distribution would have been not so different: the median ages of the population and labour force would have been virtually unchanged, the proportions of young and old altered only a little, and the dependency measures nearly identical to the actual ones of scenario 1. The caveat that we are able to take account only of primary effects should be kept in

mind; had fertility rates not risen to the levels that they did in the 1950s and earlier 1960s it is quite possible that participation rates would have taken a different course, that government policy on immigration would have been different, and that there would have been other secondary effects. Taking the calculations at face value though, and considering only broad features, had there been no baby boom the population and labour force would have been somewhat smaller in 2001 but otherwise roughly similar to what in fact they were.

Eliminating the baby bust is quite another matter. Not allowing the fertility level to fall after 1965 (scenario 3) causes a huge increase in the population by 2001 (some 37 percent above actual), a large (though not as large) increase in the labour force (19 percent), much higher rates of growth in both cases (especially in the labour force, at 15 percent per half-decade), major shifts in age distribution (for the population a median of about 27 years compared to 37, for the labour force about 36 compared to 39), and a much higher dependency ratio, whichever definition one chooses. It seems clear then that if the baby bust had not occurred, the implications for the year 2001 would have been much more profound than if the baby boom had not occurred. That that is so is further made evident by eliminating both the boom and the bust, as in scenario 4. The population and labour force are smaller in scenario 4 than in scenario 3 (though still well above either of the two previous scenarios), but in other respects the scenarios produce quite similar results: the growth rates, age distribution summary measures, and dependency ratios are all quite close. That is to say, eliminating both the baby boom and the baby bust has effects on distribution and growth rates generally similar to those produced by eliminating only the baby bust.

What if the bust were not eliminated but merely delayed for a decade; what if its onset had occurred in 1976 rather than 1966, that is, or equivalently, what if the boom had continued for another ten years (scenario 5)? The results here are generally predictable from the previous ones:

a somewhat larger population and labour force than the actual ones in 2001, growth rates that are a little higher, a somewhat younger age distribution, and very little change in dependency ratios. Alternatively, what if the bust had begun when it did, but its downward continuation had been arrested by not allowing the total fertility rate to fall below the natural replacement level (scenario 6)? In this case the TFR becomes 2.1 in 1972 and all subsequent years, implying larger numbers of children born into the population during the last three decades of the century, with a consequent lowering of the median age of the population (compared with scenario 1) and concomitant shifts in the young and old proportions. The age structure of the labour force is affected only slightly but there is a small though significant rise in the 1996-2001 rate of growth, reflecting the increased numbers of new young entrants in the final decade of the simulation period. With the larger proportion of children in the population the dependency ratios are higher, but only a little.

This brings us to the final two counterfactual scenarios, the ones that involve changes in the historical migration and labour force participation rates, and which are included to permit comparisons with the effects of fertility changes. Eliminating all immigration and emigration (scenario 7) lowers the 2001 population by 28 percent and the labour force by 29 percent, and induces sharp declines in their rates of growth, especially the population rate of growth, which is nearly down to zero – 1.2 percent over five years, or about a quarter of one percent per annum. (The labour force, like the population, would eventually stop growing altogether, and then go into decline as the full effects of the below-replacement fertility levels came to be felt; however, we are getting ahead of our story.) The effects on size and growth rates are hardly surprising. What is particularly interesting are the effects – or rather lack of effects – on age distribution: in spite of the well known high rates of immigration since World War II, eliminating all migration into or out of the country over the past fifty years changes the 2001 median age of the population

and labour force only a little, and similarly for the old and young proportions and the dependency ratios. The pattern of population aging in Canada has been quite insensitive to international migration.

Changing the historical labour force participation rates – in particular, freezing them at their 1951 levels for all age-sex groups, as in scenario 8 – obviously has no direct effect on the population. As it turns out, it has only a very small effect on the age distribution of the labour force itself in 2001, as reflected in the median age. (Needless to say, it has a very large effect on the sex distribution, although that is not shown in Table 1.) On the other hand, the effect on the size of the labour force is very large indeed, a consequence of the huge increases in the participation rates of women. Had participation rates in fact not changed over the 50 years of the simulation period the labour force would have been 18 percent smaller in 2001 than it actually was. To put the participation rate increases in perspective, and to relate their effects to those found in the fertility scenarios, eliminating the baby bust entirely (scenario 3) produced a 19 percent increase in the 2001 labour force. The post-war transformation of women's participation is thus on a par with the fertility-induced demographic transformation in its importance for the growth of the labour force to its 2001 size: the size-augmenting effects of the one provided a large offset to the size-reducing effects of the other.

## 5. SOME SCENARIOS FOR THE FUTURE

We turn now from counterfactual “what if” scenarios for the past 50 years to projections for the next 50, based on alternative scenarios for future fertility, and for comparison future immigration and labour force participation rates. The instrument for exploring the scenarios is the MEDS demographic projection program (Denton, Feaver, and Spencer, 1994a, 1997). The

scenarios themselves are as follows:

(A) Constant fertility (standard case): The total fertility rate is set at 1.54 in 2001 (that being the rate in 1998, the latest year for which a rate is available from Statistics Canada). It remains at that level throughout the projection period, as do all of the age-specific fertility rates. Immigration is set at 225,000 per year, a figure chosen to accord roughly with recent levels and announced government policy. (The figure falls in the current policy target range of 210,000 to 235,000.) Total emigration is set as a fixed proportion of the population. The age-sex distributions of immigrants and emigrants are based on observed recent average distributions. Mortality rates are assumed to continue to decline, but at a decelerating pace, with the result that male life expectancy rises from 76.3 in 2001 to 81.3 in 2051, female life expectancy from 81.7 to 85.1. Labour force participation rates change slowly in accordance with recent trends until 2016, after which they remain constant in each age-sex group.

(B) Sharp decline in TFR: The Canadian total fertility rate falls to 1.2 by 2011 in this scenario, a level close to the recent rate in Newfoundland<sup>3</sup>. Other assumptions are the same as in scenario A.

(C) TFR rises to natural replacement level: The total fertility rate increases to 2.1. Other assumptions are unchanged.

(D) TFR rises beyond natural replacement level: The total fertility rate increases to 2.5, a level last seen in the late 1960s. Other assumptions are unchanged.

(E) TFR rises to pre-baby-boom level: The total fertility rate increases to 3.0, approximately the level in 1945, just before the commencement of the baby boom. Other assumptions are unchanged.

(F) Higher immigration: Annual immigration increases to 50 percent above the standard



(scenario A) level, the increase taking place over the period 2001 to 2011 with linear interpolation for the years in between, and no further change after 2011. Fertility is constant (as in scenario A) and other assumptions are unchanged.

(G) Much higher immigration: Annual immigration increases to 450,000 per year by 2011, or double the standard assumption. Fertility is constant (as in scenario A) and other assumptions are unchanged.

(H) Higher labour force participation rates: The remaining gaps between male and female participation rates are closed: female rates increase to male levels by 2011 and remain the same as the male rates thereafter.

## 6. PROJECTIONS

The MEDS projection program moves the population and labour force ahead one year at a time, starting from 2001, and thus generates complete 50-year time paths. To conserve space though we present in Table 2 results for only two years, 2021 and 2051. The year 2021 is chosen because 20 years is too short a period for changes in fertility to affect the labour force in any significant degree so that any changes must be the result almost entirely of the initial age structure, or of migration or changes in participation rates. Conversely, the year 2051 allows several decades for fertility changes to have their effect on the labour force, as well as the population. The results for those two years are summarized in the table in the same way as the counterfactual historical results of Table 1. In addition, the projected 5-year rates of growth of the population and labour force are plotted annually in Figures 3 and 4 for selected projections, together with historical rates. Population/labour force dependency ratios, projected and historical, are plotted in Figure 5.

What will 2021 look like under the alternative scenarios? If the recent fertility level is

maintained, as in scenario A, there will of course be a shift in age distribution toward the older end: the median age will rise to about 42, an increase of 5 years, or a quarter of a year per annum over the 20-year period; the share of the 65-and-older age group will increase from a little less than 13 percent to a little less than 19; and the share of the under-20 group will fall from more than 25 percent to just under 21. The 5-year rate of growth of the population will decline to a mere 2.8 percent while the labour force will cease to grow at all. Population aging and the disappearance of growth are thus the dominant characteristics of the scenario A projection, which we take as the standard for comparison with the others.

A further decline in fertility, as in scenario B, where the TFR falls to 1.2 (from 1.54 in 2001), simply exaggerates both trends. An increase in the TFR to 2.1 (scenario C) moderates them somewhat, and increases to 2.5 and 3.0 (scenarios D and E, each of which – but especially E – seems unlikely in present circumstances) have greater effects, producing large gains in the percentage share of the under-20 age group. But while the percentage share of the 65-and-over group is affected in some degree, it continues to rise substantially in all cases, and the increased numbers of children in the higher fertility scenarios combine with the older population to raise the dependency ratios appreciably. As noted, the effects of fertility on the labour force are slight over a 20-year period, and so the labour force rate of growth remains close to zero. In short, increases in fertility over the period 2001 to 2021 – even very large ones – will not stop the proportion of older people in the population from rising substantially or labour force growth from virtually disappearing.

What about immigration: what effects would raising immigration targets have over the 20 years (assuming the targets could be attained)? Scenario F assumes a 50 percent increase in the annual number of immigrants by 2011 (from a base of 225,000), scenario G assumes a 100 percent increase. The first thing to note is that even doubling the number of immigrants has only

a rather minor effect on the age distribution of the population, and a smaller effect still on the labour force age distribution. The size and rate of growth are increased in both cases of course, but the clear imprint of population aging remains. The dependency ratios are hardly affected by raising the annual number of immigrants to as much as 450,000, in scenario G.

That leaves the effects of higher labour force participation rates to be evaluated. Scenario H assumes that the female rates will rise, until by 2011 they are the same as the male rates in all age groups. The effects are confined to the labour force, of course; the population remains the same as in scenario A. There is some effect on the rate of growth of the labour force as long as the female rates are rising, and some permanent effect on size: by 2021 the labour force is almost 7 percent larger under scenario H than under scenario A. Since the population is the same in both scenarios, the population-based dependency ratio is unaffected but the population/labour force ratio is lower: 1.87, compared with 1.99 in scenario A. However the male/female participation gaps have been closed at that point, and except for some very minor interactions between the new rates and population changes in particular age groups there is no scope for a further contribution to labour force growth. The growth rate in 2021 is thus virtually zero in scenario H, as it is in scenario A. The lasting effects of the participation rate changes are the one-time size and dependency ratio effects.

Now we go out 30 more years and look at 2051. By then changes in fertility will have had a considerable period in which to affect the labour force, as well as the population. Needless to say the alternative fertility scenarios produce much different totals: the decline of the TFR to 1.2 in scenario B produces a population and labour force some 10 percent smaller than those of scenario A (in which the TFR remains fixed); at the other extreme, scenario E, with its TFR of 3.0, produces a population that is 56 percent larger and a labour force that is 46 percent larger. A rise of the TFR to 2.1 – seemingly a more realistic possibility – raises the totals to 19 and 17

percent above the scenario A levels. Under scenario A, the median age of the population increases to between 46 and 47; under scenario B it climbs to almost 51, and the population 65 and over reaches 29 percent of the total. Much lower medians result from allowing the TFR to rise to 2.1 or higher. Big increases in immigration (scenarios F and G) produce big increases in the total population, but have only small effects on its age distribution, a result consistent with our previous counterfactual findings for 2001 and our projection results for 2021. The higher participation rates of scenario H have long since had their effects on growth by the end of the projection period, and the labour force is thus 7 percent higher than under scenario A in 2051, about what it was in 2021. Immigration and increases in fertility rates would seem to be the only possible sources of any substantial labour force growth, and if one believes that fertility rates are destined to remain about where they are now that leaves only immigration. But even doubling the annual number of immigrants produces a 5-year labour force growth rate of only 2.2 percent in 2051, or just over 0.4 percent per year. Without a major increase in fertility levels in the coming decades or extremely high (and rising) levels of immigration, the long-run prospects for growth of the labour force are poor<sup>4</sup>.

The effects of fertility, immigration, and participation rates stand out clearly in Figures 3 and 4, where the time paths of growth rates are shown for several of the projections, along with previous postwar history. With the fertility level constant (scenario A) and no increase in immigration, the population rate of growth falls continuously throughout the projection period and the population reaches a no-growth state by the end of it; if fertility is allowed to fall (scenario B), the downward trend is of course accelerated. Much the same can be said about the rate of growth of the labour force, but here the no-growth state is arrived at sooner, effectively within the first two decades of the century. Again, a very large increase in fertility or immigration would be required to maintain positive long-run growth in the labour force, and even then the

very high growth rates of the first four postwar decades would never be matched.

The population/labour force dependency ratios plotted in Figure 5 tell an interesting story. The ratio in 2001 was at an all-time (postwar) low. It may fall a little further but it will almost certainly increase as the baby boom cohorts move into retirement in large numbers. Scenario E, with its much higher fertility rates, and consequently many more dependent children, shows the ratio rising almost right away; all the others show it falling first, and then rising after a decade or so into the century. What is perhaps striking though is that under none of the scenarios does the ratio rise to anything like the levels of the 1950s and early 1960s, the baby boom years. The dependents of the coming decades will be largely of a different age group, of course – elderly rather than children – but the comparison may help to put the much anticipated “aging crisis” in some perspective.

## 7. SUMMING UP: THE EFFECTS OF FERTILITY, PAST AND FUTURE

The historical changes in fertility rates since World War II have obviously had a huge and lasting effect on the age structure of the population and labour force. The baby boom is most often cited as the cause of that effect. However it is not so much the boom itself that is responsible but the bust that followed, and the long slide of fertility rates from the high levels of the 1950s and earlier 1960s to the below-replacement levels of the 1970s, 1980s, and 1990s. Eliminating the boom (as a counterfactual experiment) reduces the size of the 2001 population and labour force somewhat but leaves the age structures not so different from what they actually were, and has hardly any effect on either of the dependency ratios that we have considered. On the other hand, removing the bust – the subsequent decline in fertility rates – has a huge effect, whether or not the boom is allowed to remain. Eliminating all international migration to and

from Canada reduces greatly the size of the population and labour force (reflecting the quantitative importance of immigration in the last half of the 20<sup>th</sup> century) but has little effect on age distribution or dependency ratios. Eliminating all changes in labour force participation rates by freezing the rates at their 1951 levels has by itself no effect on the population in 2001 but a big effect on the size of the labour force, and consequently on the population/labour force dependency ratio – a reflection in both cases of the profound importance of the changes in female participation patterns over the half-century.

Looking to the future, if fertility rates remain at the levels of recent years, or fall to even lower levels, the population and the labour force will stop growing, and eventually start to decline. Increases in fertility to the natural replacement level or higher would of course alter the situation, although it would be two decades or so before the effects on the labour force would begin to be felt. The age distribution of the population would of course respond to fertility increases, but even if the total fertility rate were to go as high as 3.0 – a very unlikely event one would think, from the present perspective – the proportion of older people in the population would still rise appreciably, and dependency ratios would increase quite sharply as larger numbers of child dependents were combined with elderly ones. Increased rates of immigration could provide some offset to the continuing effects of low fertility rates and (in contrast to fertility changes) would have an immediate impact on the labour force. However, even a doubling of recent annual rates would have only a minor effect on age distribution; it could lower the ratio of population to labour force, but only a little. Increased female labour force participation rates would have more of an effect on the ratio but once the increases had occurred there would be no further effects from that source. Whatever happens, it is very hard to see how the annual rate of growth of the labour force could ever reach the levels attained in the second half of the last century. But it is also hard to see how the population/labour force dependency

ratio could ever rise to the levels of the baby boom period (and if female participation rates were to increase to male levels the ratio might never go even as high as it was as late as the 1970s). Population aging, slower rates of growth, and increased dependency ratios would seem to be the likely features of the coming decades but in light of the historical record one should be careful not to overestimate the prospective “dependency burden”.

## ENDNOTES

1. Romaniuc (1984), George, Nault, and Romaniuc (1991), Heuveline (1999), and Statistics Canada (various years) explore the demographic implications of the baby-boom-bust sequence. Alvarado and Creedy (1998), Disney (1996), Fortin (1989), Golini (1996), McMillan and Baesel (1990), and von Weizsacker (1995) focus on government expenditure items and/or general economic implications. Beaudry, Lemieux, and Parent (2000) assess some implications of demographic change for the youth labour market, Venne (2001) focuses attention on the implications of aging for labour force and career patterns, and Dowd, Monaco, and Janoska (1998) assess the macroeconomic effects of future demographic changes. Our own work has focused on demographic changes (Denton, Feaver, and Spencer, 1994a, 1998a, 1998b) and their implications for health care personnel and facilities (Denton, Gafni, and Spencer, 1994, 1995a, 1995b), health care expenditures (Denton and Spencer, 1975a, 1983a, 1995), public pension expenditures (Denton, Robb, and Spencer, 1980, Denton, Feaver, and Spencer, 1980, Denton and Spencer, 1981), government budgets as a whole (Denton and Spencer, 1978, 1985, 1997, Denton, Feaver, and Spencer, 1986), and the macroeconomy (Denton and Spencer, 1973, 1975b, 1997, 1998a, 1998b, Denton, Mountain, and Spencer, 1996). Denton and Spencer (2000) provide a survey of the issues and evidence associated with population aging and its economic costs.
2. Denton and Spencer (1983b, 1984, 1988, 1989) develop a more comprehensive framework in which a variety of secondary effects are explored, including feedback effects on fertility.
3. Foster (2000) discusses the limits to low fertility; Lesthaeghe and Willems (1999) consider whether low fertility is likely to persist in the European Union.
4. On the levels of immigration necessary to keep the rate of growth of the labour force from declining in the period up to 2036, see Denton, Feaver, and Spencer (1999). According to the calculations in that paper, annual immigration would have to be almost 600,000 by the decade 2026-2036.



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Table 1: Characteristics of the Population and Labour Force in the Year 2001 Under Alternative Historical Scenarios

	Historical scenario							
	Actual	No boom	No bust	No boom or bust	Delayed bust	Moderated bust	No migration	Constant LF participation rates
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<u>Population</u>								
Size ('000)	31,082	28,866	42,501	38,209	34,520	33,914	22,231	31,082
Size (index)	100.0	92.9	136.7	122.9	111.1	109.1	71.5	100.0
Growth rate (%)	4.8	4.8	10.6	10.3	5.9	6.6	1.2	4.8
Median age	37.2	37.3	26.9	28.3	34.0	34.5	38.0	37.2
% under 20	25.5	24.7	38.3	36.4	26.3	30.0	25.2	25.5
% 65+	12.6	13.6	9.2	10.3	11.4	11.6	13.9	12.6
<u>Labour force</u>								
Size ('000)	16,340	15,038	19,514	17,630	18,344	17,023	11,567	13,393
Size (index)	100.0	92.0	119.4	107.9	112.3	104.2	70.8	82.0
Growth rate (%)	8.8	8.1	15.3	13.8	10.8	11.0	5.6	7.6
Median age	38.9	38.6	35.5	35.5	36.8	38.2	39.3	39.2
<u>Dependency ratios</u>								
Pop/Pop 20-64	1.62	1.62	1.90	1.87	1.60	1.71	1.64	1.61
Pop/LF	1.90	1.92	2.17	2.16	1.88	1.99	1.93	2.32

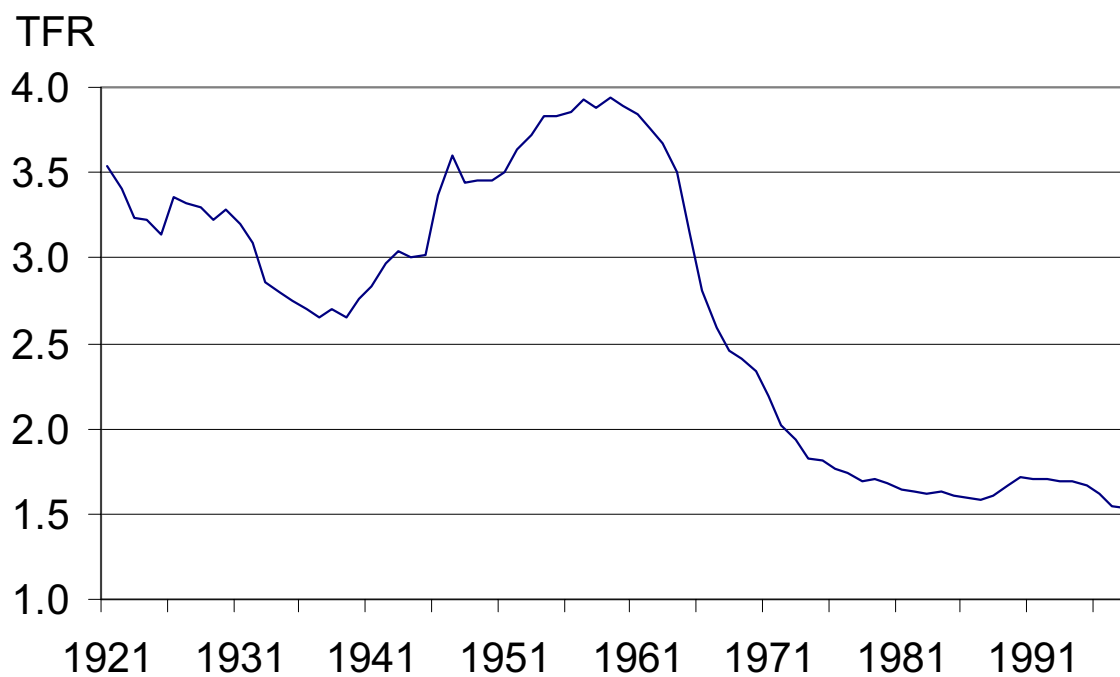
Note: Growth rate is the five-year rate in the period 1996-2001. See text for definitions of scenarios.

Table 2: Population and Labour Force Projections to 2021 and 2051 Under Alternative Future Scenarios

	Future scenario							
	Constant TFR	TFR falls to 1.2	TFR rises to 2.1	TFR rises to 2.5	TFR rises to 3.0	Immigration 50% higher	Immigration doubles	Higher LF participation rates
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
<b>2021</b>								
<u>Population</u>								
Size ('000)	35,633	34,503	37,502	38,834	40,498	37,504	39,359	35,633
Size (index)	100.0	96.8	105.2	109.0	113.7	105.3	110.5	100.0
Growth rate (%)	2.8	1.7	4.4	5.5	6.8	4.5	6.1	2.8
Median age	42.4	43.6	40.5	39.1	37.4	41.6	40.8	42.4
% under 20	20.8	18.1	24.8	27.4	30.4	21.2	21.6	20.8
% 65+	18.6	19.2	17.7	17.1	16.4	17.9	17.3	18.6
<u>Labour force</u>								
Size ('000)	17,878	17,841	17,938	17,982	18,036	18,960	20,032	19,069
Size (index)	100.0	99.8	100.3	100.6	100.9	106.1	112.0	106.7
Growth rate (%)	0.0	-0.2	0.4	0.7	1.0	2.1	3.9	0.2
Median age	40.5	40.5	40.4	40.3	40.2	40.1	39.8	41.0
<u>Dependency ratios</u>								
Pop/Pop 20-64	1.65	1.60	1.74	1.80	1.88	1.64	1.64	1.65
Pop/LF	1.99	1.93	2.09	2.16	2.25	1.98	1.96	1.87
<b>2051</b>								
<u>Population</u>								
Size ('000)	37,465	33,590	44,693	50,467	58,415	43,507	49,495	37,465
Size (index)	100.0	89.7	119.3	134.7	155.9	116.1	132.1	100.0
Growth rate (%)	-0.2	-1.8	2.4	4.3	6.5	1.4	2.7	-0.2
Median age	46.5	50.8	39.7	36.0	31.9	45.1	44.2	46.5
% under 20	18.8	14.8	25.3	29.6	34.5	19.5	19.9	18.8
% 65+	25.9	29.0	21.7	19.1	16.5	24.2	22.9	25.9
<u>Labour force</u>								
Size ('000)	17,238	15,497	20,194	22,360	25,136	20,431	23,596	18,444
Size (index)	100.0	89.9	117.1	129.7	145.8	118.5	136.9	107.0
Growth rate (%)	-0.6	-2.9	2.7	4.8	7.3	1.0	2.2	-0.6
Median age	40.9	42.8	38.7	37.5	36.4	40.7	40.5	41.5
<u>Dependency ratios</u>								
Pop/Pop 20-64	1.81	1.78	1.89	1.95	2.04	1.78	1.75	1.81
Pop/LF	2.17	2.17	2.21	2.25	2.32	2.13	2.09	2.03

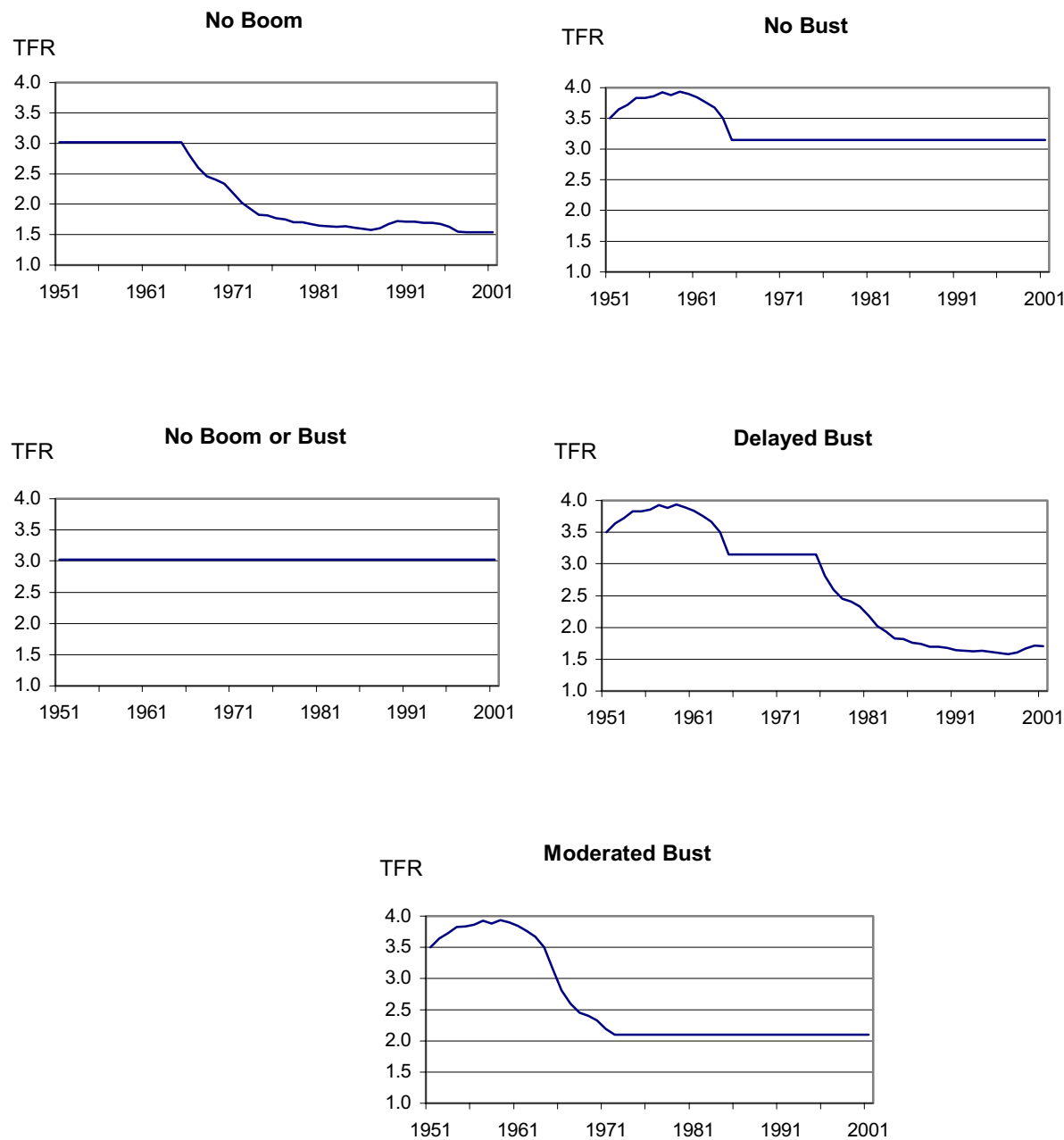
Note: Growth rate is the five-year rate in the period 1996-2001. See text for definitions of scenarios.

**Figure 1: Canadian Total Fertility Rates (Period Basis), 1921-1998**



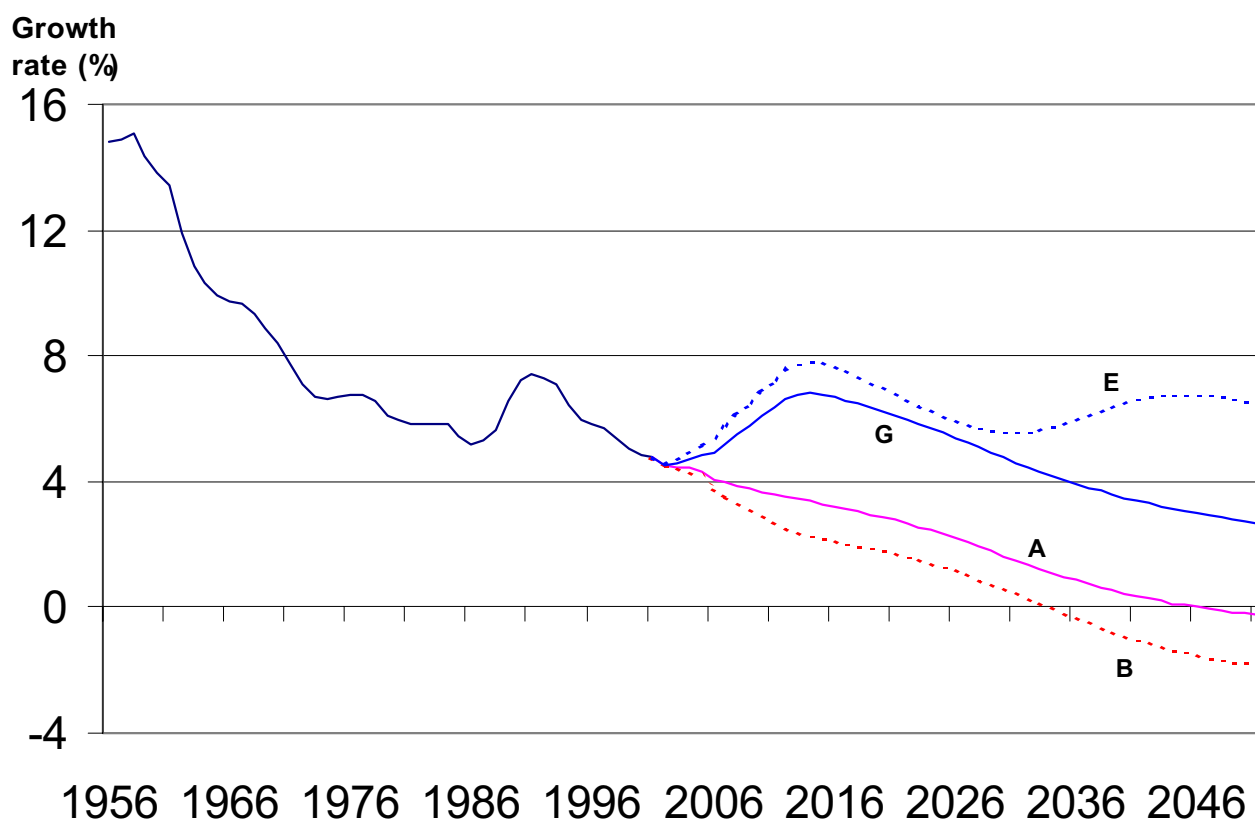
Source: Statistics Canada 82-553 Selected Birth and Fertility Statistics for 1921 to 1973; 91-209 Report on the Demographic Situation in Canada for 1974 to 1998.

**Figure 2: Counterfactual Historical Fertility Rate Scenarios**



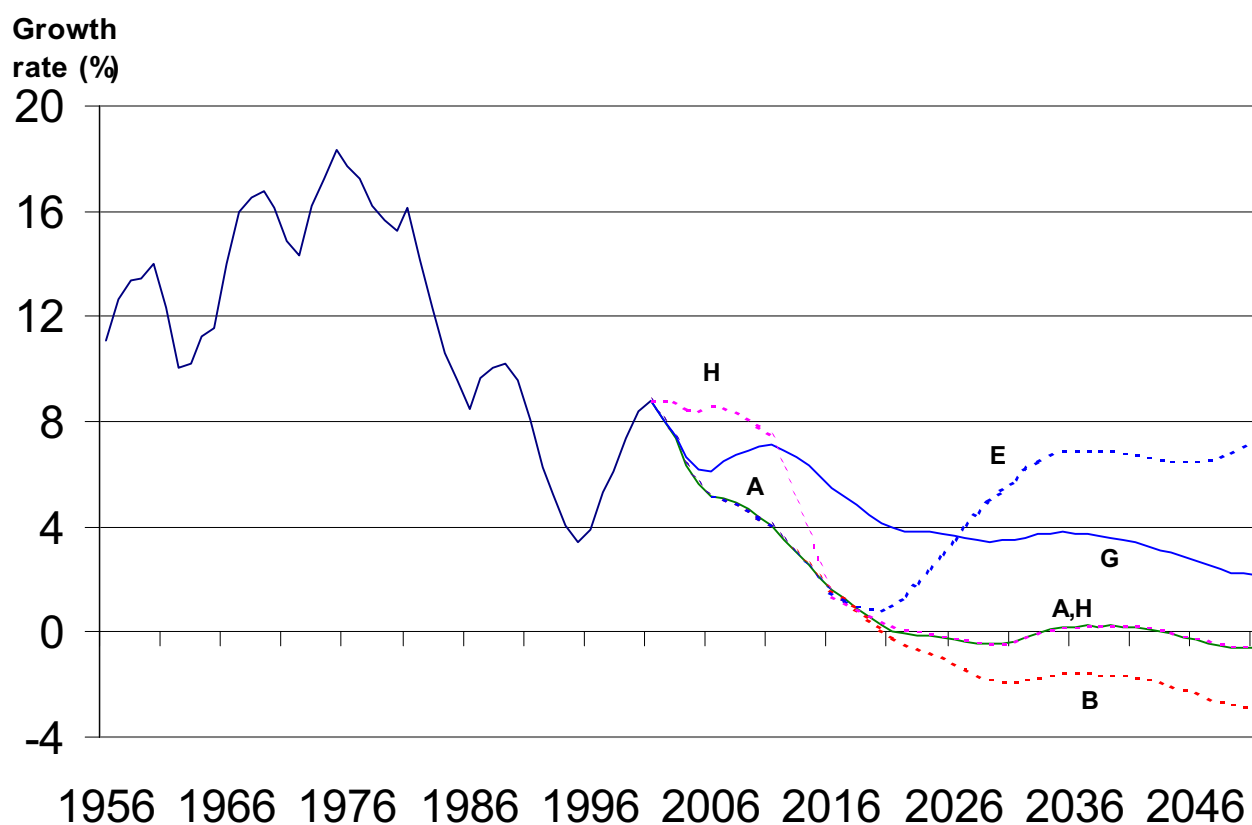


**Figure 3: Five-year Rates of Growth of the Canadian Population, Historical and Projected**



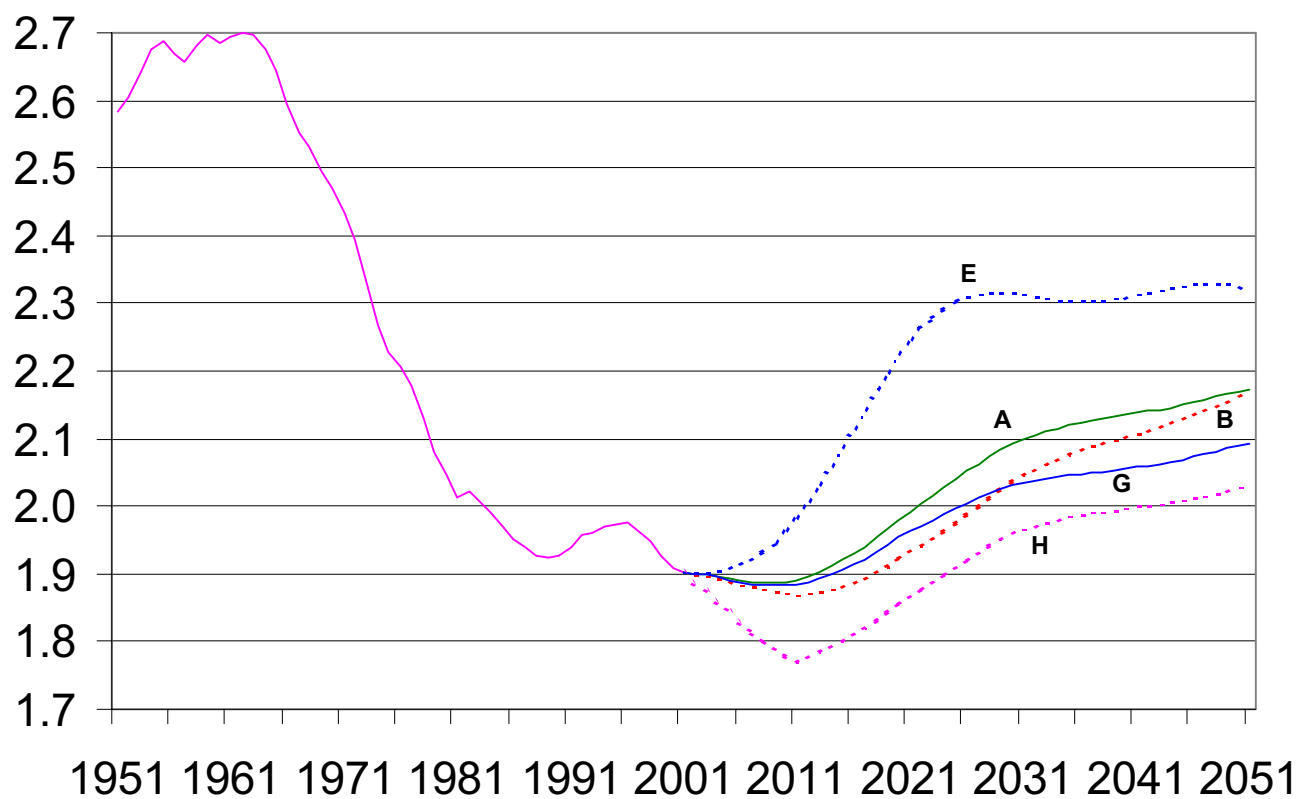
Note: Growth rate refers to the five years preceding the middle of the year indicated. See text for definitions of projection scenarios A, B, E, and G and comments on data sources and adjustments.

**Figure 4: Five-year Rates of Growth of the Canadian Labour Force, Historical and Projected**



Note: Growth rate refers to the five years preceding the middle of the year indicated. See text for definitions of projection scenarios A, B, E, G, and H and comments on data sources and adjustments.

**Figure 5: Canadian Dependency Ratios (Population/Labour Force), Historical and Projected**



Note: Dependency ratios are based on the population and labour force data underlying Figures 3 and 4; see notes to those figures.

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